

Control sec 4

$$GH(s) = \frac{K(s+2)(s+6)}{s^2(s+4)(s^2+4s+8)}$$

① $n_p = 5$ & $n_z = 2$



② Real Part

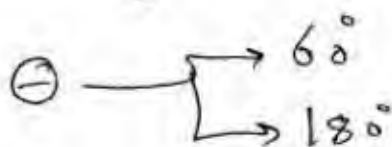
$$-2 \rightarrow -4 \mid -6 \rightarrow -\infty$$

③ Asymptotes

$$n_o = 5 - 2 = 3$$

$$\sigma_A = \frac{(0+0-2+2j-2-2j-4-6) - (-2)}{3} = \frac{-12}{3} = -4$$

$$\theta = \frac{(2L + 1) \times 180^\circ}{3} = (2L + 1) 60^\circ$$



④ Breaking points

Breaking in zeros (zeros) بين ال

$$K = \frac{-1}{GH(s)} \Rightarrow \frac{-s^2 (s+4) (s^2+4s+8)}{(s+2)(s+6)}$$

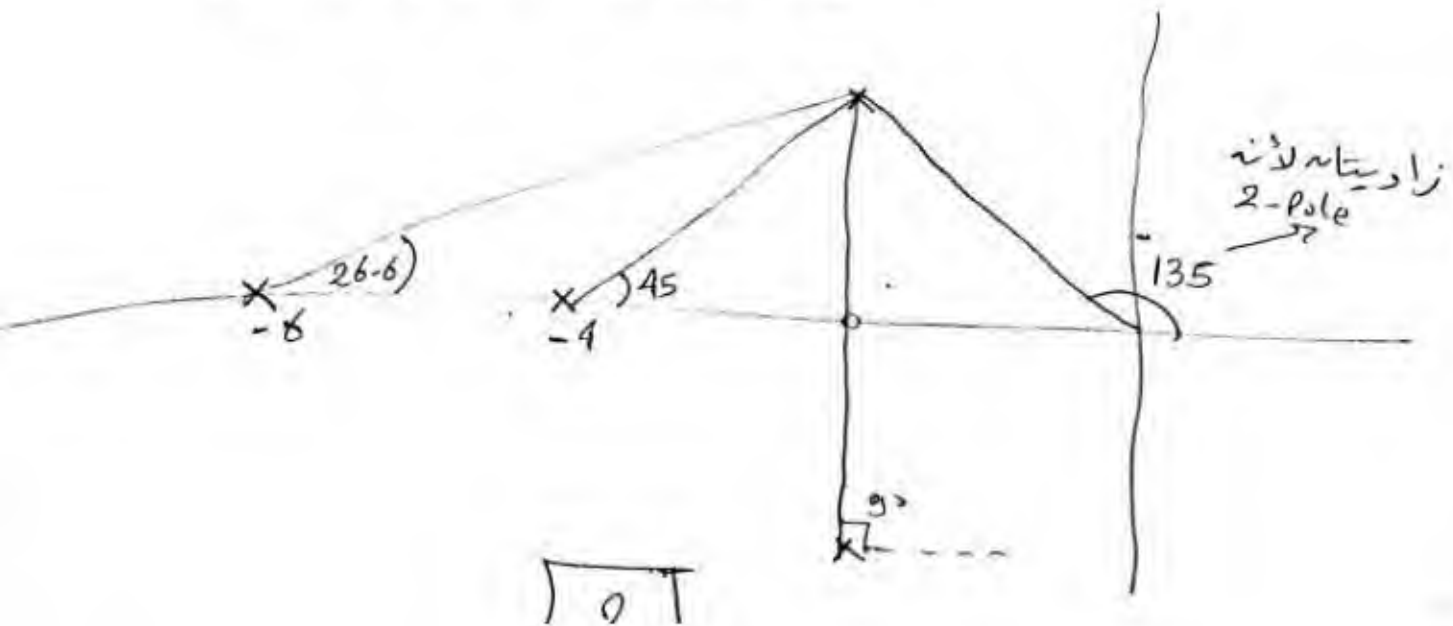
σ	-6	-6-5	-7	...
K				

$K = \min$

← هتجرب قيم من الجداول حتى نصل لقيمة تزيد عن 0 قيمة
 K تكون K_{min}

⑤ Departure Angle.

$$D = 180 - \phi_p + \phi_z$$



$$\phi_a \approx 180 - (135 + 135 + 135) + 90 + 26.6$$

$$= -108.4$$



⑥ Range of K for stability (Routh)

$$1 + KGH(s) = 0$$

$$s^2(s+4)(s^2+4s+8) + K(s^2+8s+12) = 0$$

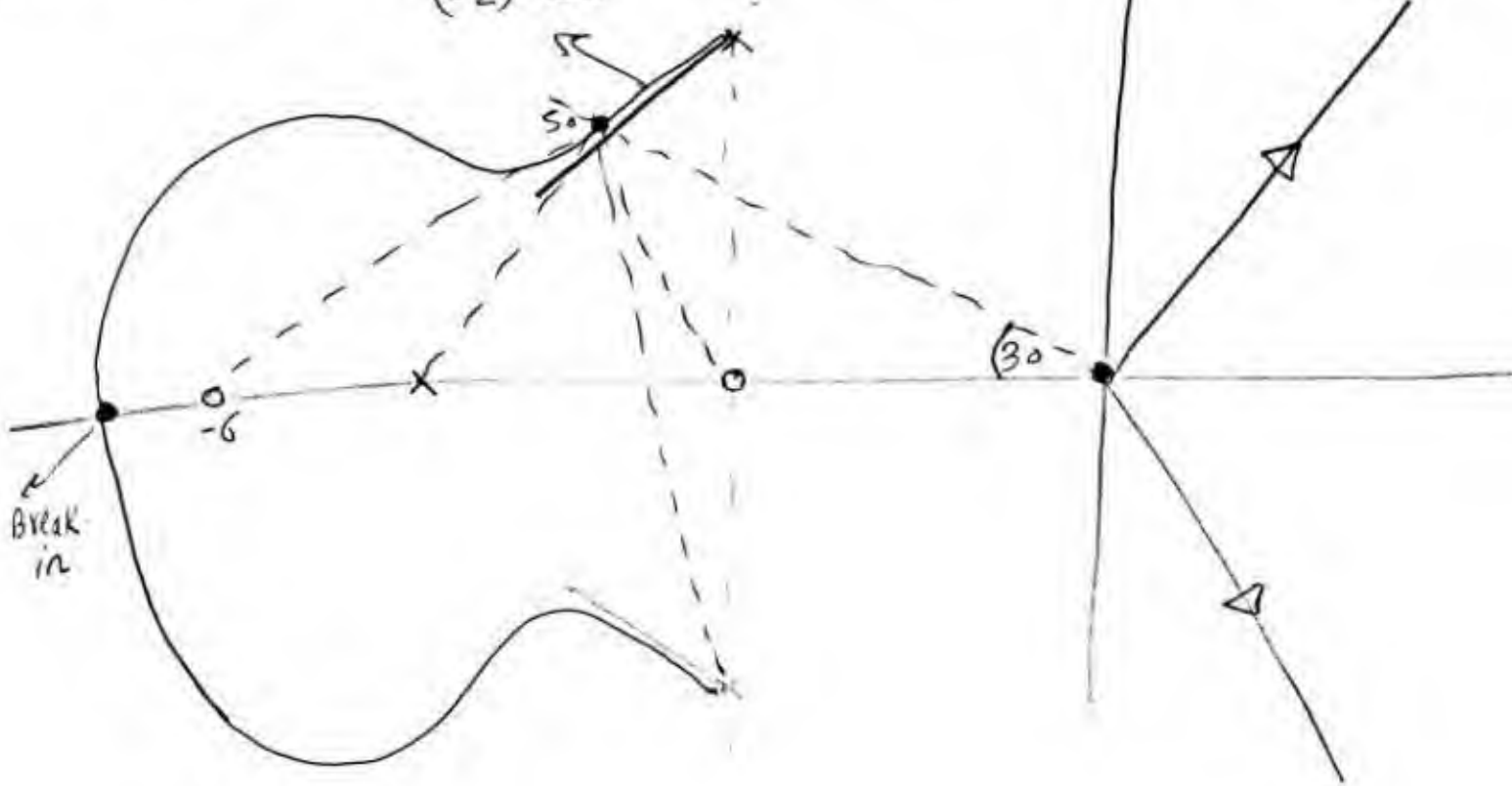
$$s^5 + 8s^4 + 12s^3 + (32+K)s^2 + 8Ks + 12K = 0$$

→ Range of K .

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(Zero) الی حلقہ بسبب ال
 (-2) is

$t_s < 4$ $t_s = 4$ $t_s > 4$



Required

$$\angle = \frac{\sqrt{3}}{2} \quad t_s \leq 4$$

$$\rightarrow \theta = \cos^{-1} \angle = \cos^{-1} \frac{\sqrt{3}}{2} = 30$$

$$K|_{s_0} = \frac{\pi \text{ Poles}}{\pi \text{ Zeros}}$$

$$t_s = \frac{4}{\omega} = 0 \quad \omega = 1$$

①

$$\Rightarrow \text{num} = [1 \quad 8 \quad 12];$$

$$\Rightarrow \text{den} = \text{conv}(\text{conv}[1 \ 0 \ 0], [1 \ 4 \ 8], [1 \ 4]);$$

$$\Rightarrow G = \text{tf}(\text{num}, \text{den});$$

$$\Rightarrow \text{rlocus}(G);$$

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